Remarks/Arguments

The Examiner is thanked for the careful review of this application. Claims 1-16 and 21 are pending after entry of the present Amendment. Claims 2 and 17-20 were cancelled. New claim 21 was added. This Amendment is being presented in the new format, as suggested.

Rejections under 35 U.S.C. § 103:

The Office has rejected claims 1-16 under U.S.C. 103(a), as being unpatentable over United States Patent 6,207,544 to Nguyen et al. (hereinafter referred to as "Nguyen") in view of United States Patent 5,912,188 to Gardner et al. (hereinafter referred to as "Gardner"). In a like manner, the Office has rejected claims 1-16 as being unpatentable over United States Patent 6,277,700 to Yu et al. (hereinafter referred to as "Yu") in view of Gardner. Applicants respectfully traverse the Office's rejections and submit that independent claims 1, 6, and 7, as amended, are patentable over the cited references, as no combination of the cited prior art would have suggested the claimed invention to one of ordinary skill in the art.

Nguyen focuses on a method for fabricating very thin silicon nitride spacers on a transistor using one anisotropic etching process. As acknowledged by the Office, Nguyen uses optical spectrometry to determine the endpoint of the etch process. Gardner, however, is directed at forming a contact hole in an interlevel dielectric using three etch steps. Gardner teaches four methods that can be implemented to determine etch endpoint: laser interferometry and reflectivity, optical emission spectroscopy, direct observation through a viewing port on the chamber by a human operator, and mass spectroscopy.

As will be explained below, the combination of Nguyen and Gardner does not raise a *prima facie* case of obviousness against the subject matter defined in independent claims 1, 6, and 7. First, this combination does not teach or suggest all of the features defined in independent claims 1, 6, and 7, as amended. Second, the requisite suggestion or motivation to combine the references in the manner proposed by the Office is lacking.

Considering first whether the combination teaches or suggests all of the claimed features, contrary to the Office's assertion, the method of fabricating very thin silicon nitride spacers on a transistor as described in Nguyen fails to disclose or suggest each and every feature of the claimed invention. For instance, Nguyen fails to disclose or suggest

implementing minimum of two etch processes. Rather, Nguyen can use one etch process. Nguyen does not teach or disclose fabricating the spacer using a first etch process that implements an interferometry endpoint (IEP) detection method (as defined in claims 1 and 6) or monitoring the light reflected by the silicon nitride spacer layer (as defined in claim 7). Instead, Nguyen uses optical spectroscopy to detect etch endpoint of the silicon nitride and does not even mention the IEP endpoint detection method.

Furthermore, Nguyen fails to teach or suggest removing a portion of the spacer layer that has a specific thickness (as defined in claim 1 and 6) using the first etch or stopping the first etch operation so as to leave a thin spacer layer (as defined in claim 7). Rather, Nguyen suggests removing the spacer layer using one etch process. As a result, Nguyen does not specifically disclose or suggest leaving a thin spacer layer after the first etch process. Additionally, as defined in the amended claim 6, the first etch process controls the removal of the portion of the spacer layer so as to maintain a thickness of the thin spacer layer substantially uniform throughout a surface of a substrate and on the gate structure. In contrast, Nguyen suggests that a first etch process can be used to remove the spacer layer. Thus, Nguyen does not disclose or teach leaving a layer for a spacer layer or maintaining a thin spacer layer that is substantially uniform.

Nguyen further fails to disclose or teach performing a second etch process that is monitored by a non-IEP etch end point process (as defined in claim 1) or optical spectroscopy (as defined in claim 7), and discontinuing the second etch process when the second etch process has continued for a predetermined period of time (as defined in claims 1 and 6) or monitoring an optical signal produced by the second plasma during the second etch operation and discontinuing the second etch operation once the etch operation has continued for a predetermined period of time (as defined in claim 7).

In a like manner, Gardner fails to disclose or suggest implementing IEP endpoint detection for etching spacers in silicon nitride. Rather, Gardner provides four methods of etch endpoint detection, in general, not directed specifically toward fabricating silicon nitride spacers using silicon nitride spacer etch. Furthermore, Gardner discloses making the spacers in an oxide layer (silicon oxide), to form oxide spacers. More importantly, Gardner uses one etch step to create the oxide spacers instead of two, as defined in the claimed invention.

Additionally, neither Nguyen nor Gardner teach or suggest using two separate etch processes using two different etch endpoint monitoring methods. Nguyen specifically teaches that it is not necessary to use two different etch processes and Gardner teaches using a single etch process to create oxide spacers.

Shifting to the issue of whether the combination of Nguyen and Gardner is proper, a *prima facie* case of obviousness based on a combination of references requires that there be some suggestion or motivation, either in the references or in the knowledge generally available to one having ordinary skill in the art, to combine the Nguyen and Gardner in the manner proposed by the Office. As will be explained below, the combination of Nguyen and Gardner is improper because one having ordinary skill in the art would not have combined Nguyen and Gardner in the manner proposed by the Office.

As discussed above, Nguyen discloses using optical spectroscopy to monitor the endpoint of the etch process. In doing so, the etch process of Nguyen cannot be stopped after a portion of a spacer layer having a specific thickness has been removed. As discussed in this application, the optical spectroscopy uses the light emission intensity of the plasma and its direct proportionality to the concentration of the silicon nitride in the etch chamber to determine the conclusion of the etching process. As such, one using the optical spectroscopy endpoint detection method as taught in Nguyen may not be able to stop the etching process once the portion of the spacer layer having a specific thickness has been removed.

Furthermore, one of ordinary skill in the art would not have arrived at the claimed invention, as defined in amended claims 1, 6, and 7, by combining the IEP etch endpoint detection method taught in Gardner with the fabrication of silicon nitride spacers using at least one etch process, as taught by Nguyen. Specifically, using IEP to detect the etch endpoint in Nguyen does neither result in etching a portion of the spacer layer having a specific thickness nor performing a second etch process for a predetermined period of time. In fact, the combination of Nguyen and Gardner would not have suggested or motivated one of ordinary skill in the art to use two different types of endpoint monitoring methods. Nor would the combination have suggested using a first IEP method and a second non-IEP monitoring method. In fact, Nguyen emphasizes that merely one etch process is necessary. As such, one reading Nguyen would not have been motivated to use two steps, each using a different endpoint detection method, as defined in claims 1 and 7. Thus, the combination of

the Nguyen and Gardner would not have suggested to one having ordinary skill in the art all of the features of amended independent claims 1, 6, and 7.

The next reference, Yu, teaches a method of etching silicon nitride spacers beside a gate structure using a main etch step and an over etch step wherein the main etch step uses an end point detection and the over etch step is a percentage of the main etch. Similar to Nguyen, Yu fails to disclose, teach, or suggest several features of the claimed invention. Among other features, Yu fails to disclose or suggest implementing a first etch process implementing an interferometry endpoint (IEP) detection method (as defined in claims 1 and 6) or monitoring the light reflected by the silicon nitride spacer layer (as defined in claim 7). Yu is silent as to the etch endpoint detection method to be used.

Furthermore, Yu does not disclose or teach a first etch process configured to remove a portion of the spacer layer that has a specific thickness (as defined in claim 1 and 6) or stopping the first etch operation so as to leave a thin spacer layer (as defined in claim 7). Instead, Yu teaches removing preferably at 95% of endpoint of the layer being etched. This however, is not an indication that removal at 95% of endpoint results in removing a portion of the space layer that has a specific thickness. As such, Yu does not specifically disclose or suggest leaving a thin spacer layer after the first etch process.

Additionally, Yu fails to disclose or suggest discontinuing the second etch process when the second etch process has continued for a predetermined period of time (as defined in claims 1 and 6) or monitoring an optical signal produced by the second plasma during the second etch operation and discontinuing the second etch operation once the etch operation has continued for a predetermined period of time (as defined in claim 7). Rather, in Yu, the over etch step is performed for a percentage of time of the main etch step time. As a result, the time for the second etch process is dependent on the first etch step which can change depending on the initial thickness of the silicon nitride layer. Nor does Yu teach using a non-IEP etch endpoint monitoring method (as defined in claim 1) for the second etch process.

Additionally, as discussed in more detail above with respect to patentability of claims 1-16 over the combination of Nguyen and Gardner, neither Yu nor Gardner teach or suggest using two separate etch processes using two different etch endpoint monitoring methods. Yu merely teaches that the first etch process has an etch point detection method and that the

second etch process is dependent on the first etch process. Nor does Gardner teach using IEP for the first etch process and a non-IEP monitoring process for the over etch process.

Furthermore, the combination of Yu and Gardner is improper because one having ordinary skill in the art would not have combined Yu and Gardner in the manner proposed by the Office. As discussed above, the first etch process in Yu has not been taught or disclosed to be stopped after a portion of a spacer layer that has a specific thickness has been removed. Rather, focus is placed on removal of up to 95% of endpoint. This, however, does not suggest removing portion of the spacer layer that has a specific thickness.

Moreover, one of ordinary skill in the art would not have arrived at the claimed invention, as defined in claims 1, 6, and 7, by combining the IEP etch endpoint detection method taught in Gardner with the fabrication of silicon nitride spacers taught by Yu. Particularly, detecting the etch endpoint using IEP in Yu does necessarily result in etching a portion of the spacer layer that has a specific thickness or performing a second etch process for a predetermined period of time. Nor would the combination of Yu and Gardner have suggested using the combination of a first IEP method and a second non-IEP method of endpoint detection or in that order. Thus, the combination of the Yu and Gardner would not have suggested to one having ordinary skill in the art all of the features of independent claims 1, 6, and 7.

Therefore, it is respectfully submitted that independent claims 1, 6, and 7 are patentable under 35 U.S.C. § 103(a) over any combination of the cited prior art. In a like manner, dependent claims 3-5, 8-16 which incorporate each and every element of the respective independent claim 1, 6, and 7 are patentable under 35 U.S.C. § 103(a) over any combination of the cited prior art for at least the same reasons discussed above.

New independent claim 21 is directed toward a method for fabricating a spacer of a gate structure. Among other features, the method includes performing a first etch process implementing an interferometry endpoint (IEP) detection process, discontinuing the first etch process, performing a second etch process implementing optical emission spectroscopy (OES) endpoint monitoring process, discontinuing the second etch process in response to the OES monitoring process. The second etch process is configured to remove a thin spacer layer remaining subsequent to a removal of a portion of a spacer layer having a specific thickness during the first etch process, leaving the spacer for the gate structure.

As discussed in more detail above with regard to independent claims 1,6, and 7, the combination of the cited prior art would not have suggested one of ordinary skill in the art to arrive at the claimed invention, as defined in new independent claim 21. Accordingly, it is respectfully submitted that new independent claim 21 is patentable over the cited art of record.

In view of the foregoing, Applicants respectfully submit that all of the pending claims 1-16 and 21 are in condition for allowance. Accordingly, a Notice of Allowance is respectfully requested. If the Examiner has any questions concerning the present Preliminary Amendment, the Examiner is kindly requested to contact the undersigned at (408) 749-6900, ext. 6913. If any additional fees are due in connection with filing this Amendment, the Commissioner is also authorized to charge Deposit Account No. 50-0805 (Order No. LAM2P295). A duplicate copy of the transmittal is enclosed for this purpose.

Respectfully submitted,
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